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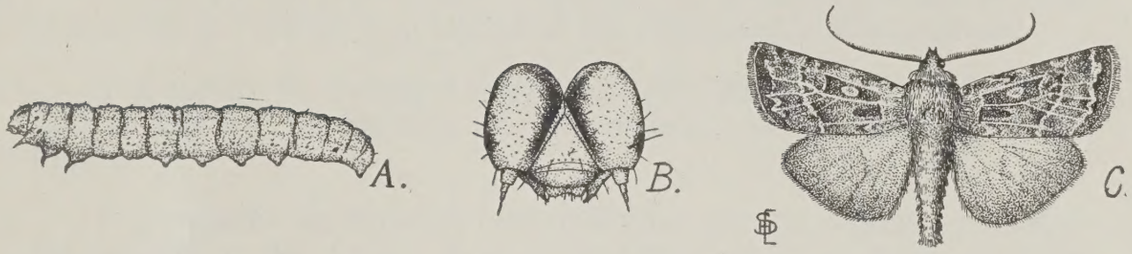
# THE PALE WESTERN CUTWORM

By H. L. SEAMANS




A—Full grown cutworm;
B—Head of cutworm enlarged;
C—Moth of Pale Western Cutworm
A and C natural size (after Seamans and Strickland).

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE

PAMPHLET No. 71—NEW SERIES
(REVISED)



THE ENTOMOLOGICAL BRANCH
ARTHUR GIBSON, Dominion Entomologist

Published by direction of the Hon. ROBERT WEIR, Minister of Agriculture,
Ottawa, April, 1931

## SUMMARY

Injury by the pale western cutworm is caused by the larval stage of a moth or " miller "; a native of the semi-arid prairie regions.

The moths fly during August and early September and lay their eggs in soft soil irrespective of the presence or absence of weeds. Page 5.

It is possible to forecast outbreaks one year in advance by keeping records of the " wet " days during the period of larval activity. Page 8.

Cutworm infestation may be avoided by proper cultivation of the fields. This requires that the ground be worked as much as is necessary up to August 1, and then left uncultivated until the middle of September so that the soil surface may become crusted. Nothing should be allowed to break up this crust when it has once formed until after the moths have stopped flying, about the middle of September.

Adopt a crop rotation that allows fields to be left untouched from August 1 to September 15. Page 10.

When a crop has been destroyed by cutworms it is not safe to reseed to any crop as long as the majority of the larvæ are still present. The time to reseed can be determined by using the chart and measuring the cutworms taken from field. Page 11.

# THE PALE WESTERN CUTWORM

By H. L. Seamans
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The pale western cutworm (*Agrotis orthogonia* Morr.) first appeared in injurious numbers in Alberta in 1911. Since that year outbreaks have been frequent in Alberta, Saskatchewan, Montana, and North Dakota, and occasionally farther south. During a severe outbreak this insect may destroy many thousands of acres of grain. There may, also, be further important losses due to the reseeding of devastated fields while the cutworms are still present.

## Determination of the Pale Western Cutworm

There are many species of cutworms that may be common in cultivated fields. Not all of these are injurious to crops and some that are injurious can be easily controlled. Most of the commoner forms can be recognized by their distinctive colours and markings.

The pale western cutworm is of a uniform slate-grey colour with a light yellowish head, on the front of which are two, distinct, short, black dashes.

If there is any doubt as to the species of cutworm causing damage in a field, a few specimens should be placed in a tin box with a little moist earth and mailed to the nearest Dominion Entomological Laboratory or Provincial Entomologist. The Dominion Entomological Laboratories for the Prairie Provinces are located at Treesbank, Manitoba; Saskatoon, Saskatchewan; and Lethbridge, Alberta. The Provincial Entomologist for each province can always be consulted through the Provincial University or the Agricultural College.

## Nature of Pale Western Cutworm Damage

The first stage cutworms are very small and they feed almost entirely above ground. They are seldom noticed and their feeding activities consist of cutting notches and holes in the leaves of young plants.

Close observation is required to see this type of damage, but when cutworms are present the injury can be noticed by May 10 or May 15 in an average season. After the larvæ start feeding below ground, the plants are usually cut off and a small portion of the underground stem is eaten. This causes portions of the plants above ground to wilt and die. If there is sufficient soil moisture, new shoots may spring up from the old roots but if not the roots, also, die. The dead upper portions of the plants blow away, leaving blank spaces in the drill rows. When the whole field has been destroyed there are no signs of the drill rows left.

During the spring of 1930 much of the grain in southern Saskatchewan was destroyed by wind and frost. However, in these fields the crowns of the old plants remained in the soil and even though the plants were killed the original drill rows were still marked by the remains of the dead plants. In most cases no cutworms were present in these fields and they could have been reseeded at once.

## Life-history

The pale western cutworm is the larval stage of a moth or "miller" which flies during the last three weeks of August and the first week of September. During the early part of the season, the moths are active only at night but as the nights grow colder the daily flight occurs in the afternoon and early evening. At this time they may be seen flying about, feeding on the nectar of flowering weeds or laying eggs in the soil.

The moths begin to lay eggs soon after they have emerged and the eggs are laid *only in soft soil.* In laying, the female moth inserts the tip of the

abdomen into the soil. When the surface of the soil is caked or crusted, conditions for egg-laying are unsuitable and the female will seek some other spot. A loose summer-fallowed field provides ideal conditions for egg-laying, although anything which tends to break up a surface crust in a field and make the top quarter of an inch dusty will serve to provide suitable conditions for egg-laying. Pastures which are continually grazed during the egg-laying period and dusty roads are often visited by the moths searching for soft soil in which to lay their eggs.

The eggs usually incubate during autumn and as a rule remain unhatched in the ground until spring. They begin to hatch when the temperature rises above freezing, provided there is sufficient soil moisture so that the eggs are wet. The maximum hatching takes place at temperatures between 50° and 70° F., but, if the eggs become dry, hatching may be delayed or the eggs may be killed at these or higher temperatures. Standing water in the field at temperatures below 70° F. will have little or no effect on the hatching of the eggs unless they are actually submerged for over ten days or two weeks. With temperatures above 70° F. the eggs submerged in water may hatch and the young larvæ be drowned. Hatching takes place over a period of two or three weeks in the spring, usually starting about the last of April. On rare occasions hatching may take place in autumn and the insects live through the winter as partially grown cutworms.

The freshly hatched larvæ are very small and feed above ground at first. However, this habit of surface feeding is soon lost and within ten days they begin to feed below the surface and thereafter continue to do most of their feeding underground. They feed throughout May and the first half of June, until they have reached a length of about one and one-half inches. If the outbreak is very severe and food is scarce the cutworm becomes partially starved and stunted and may be mature when it has reached a length of an inch or one and one-quarter inches. At this time it is full grown and forms a small cell in the soil about three inches below the surface. It remains in this cell for a time, feeding occasionally, and finally changes to a dark-brown pupa, from which the moth emerges later. The moths begin to fly about in search of food and suitable egg-laying soil about the end of the first week in August.

## Distribution of Outbreaks

The pale western cutworm is a native of the treeless Great Plains area of North America. Severe outbreaks are confined largely to the northwestern portion of this area and their location and severity is governed by the weather.

A study of climate in relation to the pale western cutworm indicates that the areas of normally low rainfall and high temperature on the treeless prairie are most favourable for outbreaks. Such an area centres on Bow Island, Alberta, and dry seasons are invariably followed by increases in the cutworm population.

During recent years severe outbreaks have occurred in areas outside of the normal climatic range of the insect due to very unusual weather conditions. These outbreaks have not spread from the older infested districts but have arisen through an abnormal increase of the native cutworm population. At Regina and Indian Head, Saskatchewan, as well as in the Drumheller district of Alberta, the seasonal weather conditions have been favourable for cutworm increase. This has been due to a lack of the normal rainfall during the period of cutworm activity combined with abnormal temperatures. With extremely dry conditions the increase of cutworms may extend to the so-called bush country or savannah area, of the prairies, but the climate that produces a natural tree growth is too humid for prolonged outbreaks of this insect. It is quite probable that two or three years of average weather conditions in these regions of recent outbreaks will so reduce the cutworm population that no further trouble will be experienced so long as the seasons remain nearly normal.

Outbreaks are not confined to any particular type of soil. For several years the pale western cutworm was supposed to be injurious only in light soils. The recent outbreaks in Saskatchewan and Alberta have been in the heavy soil areas. Investigations have shown that it is not the type of soil but the condition of the surface which governs the location of the cutworm infestation. Any field in which the soil surface is loose and dusty during the egg-laying period of the moths is likely to be infested with cutworms the next spring.

## Causes of Outbreaks

The pale western cutworm, a native prairie insect of the semi-arid regions, has been widely collected over the prairies and both moths and larvæ have been found at distances from cultivated areas. Under natural conditions the larvæ evidently live above the surface of the ground and feed for the most part on the leaves and stems of native grasses. The various enemies have ready access to the larvæ and bring about a natural control. With the cultivation of the soil for crops the larvæ have been able to move about below the surface with a certain amount of ease and this species has, apparently, begun a new mode of life. Instead of moving about and feeding above the ground it now feeds largely upon the stems of plants about an inch below the soil surface and moves about in the softer soil where its various enemies seldom reach it. When the soil is very wet the larvæ are forced to the surface, where they remain until it begins to dry out. At such times they are again upon the surface of the soil and are accessible to their enemies.

Outbreaks of this insect are thus due to a change in the mode of life and are controlled by natural enemies and weather conditions. Two or three seasons of little moisture during the period of larval activity favour the increase of these cutworms by allowing them to remain under the surface of the soil and out of reach of their natural enemies. A wet season, or one in which the rainfall during the period of larval activity is so distributed as to bring the cutworms to the surface frequently, favours the natural control by increasing the possibility of attack by natural enemies. Such a season is usually followed by a decrease of cutworms the following year.

A wet season, also, greatly reduces the amount of damage that may be caused by cutworms. In the average "dry" season an infestation at the rate of six cutworms per square yard is sufficient to destroy the entire crop. This is due to the cutworms feeding on the plants below ground and eating only a small portion of each plant. With excessive moisture the cutworms may feed on the upper portions of the plant and one plant will furnish enough food for several days. In addition some of the injured plants will recover and send out new stalks.

## Natural Control

The natural control of the pale western cutworm is brought about by two classes of enemies—parasites and predators. The parasites may be other insects or diseases which live either on or in the cutworms and eventually kill them. Predators are insects or birds which more directly attack and devour the cutworms.

Of the parasitic insects, some lay their eggs on the food of the cutworm, some on the outside of their bodies, and others actually inside the body of the cutworm. In the first case the eggs hatch after they have been swallowed with the food and the young parasites feed upon and develop within the cutworm's body. In other cases the eggs hatch and the parasites develop either on the inside of the cutworm or remain and feed upon the outside. In order to become parasitized the cutworm must either be present above the surface of the soil or must feed upon the exposed portions of the plant.

Diseases have not been found to be of any importance in the field.

Predators seize the cutworms bodily and devour them. Some of the predaceous insects dig the larvæ out of the soil and others secure them only when

the cutworms are moving about on the surface. The crow is one of the most valuable predators of the pale western cutworm. From sunrise until sundown crows in hundreds may be seen flying to and from the fields, digging the cutworms from the soil or picking them up on the surface after a shower. The horned lark, curlew, Franklin's gull, blackbird, and occasionally mallard ducks, have, also, been observed feeding upon the cutworms in the fields.

### Forecasting Cutworm Outbreaks

It is possible to foretell, with reasonable certainty, a year in advance, what the cutworm situation is likely to be. Since the weather plays such an important part in the activity of the larvæ and their control by natural enemies, it can be utilized to determine whether there will be an increase or decrease during the following year. One-quarter of an inch of rainfall is sufficient to bring the cutworms to the surface of the ground. Here they will remain somewhat exposed, until the soil becomes dry enough for them to do down again. If the sun is bright after rain they seek shade and are hidden, but if the weather remains cloudy they may become active and behave very much like ordinary surface-feeding cutworms.

It has been found that when the fields are too wet to use a disc-harrow the cutworms are also likely to be on the surface, and a day with the soil in such a condition, whether raining or not, must, therefore, be considered as a "wet" day in forecasting. When it is not actually raining an observation in the field will be required to determine the moisture condition of the soil and whether or not it could be easily disked.

Since the weather conditions only during the period of larval activity appear to have any influence on the increase or decrease of the cutworm population, it is impossible to use definite calendar periods for making observations. A hot, dry May will cause the cutworms to develop rapidly so that they may be mature by the middle of June, while a cold spring may so retard development that larvæ are still feeding in July. If weather conditions, and especially the soil moisture, are observed during the period in which the majority of the cutworms are active and feeding, a forecast of the probable conditions for the next season can be quite accurately made by using the following method:—

**If there are less than ten "wet" days during the period of larval activity, there will be an increase in the number of cutworms the following year.**

**If there are between ten and fifteen such days during the period of larval activity, there will in all probability be some decrease in the numbers of cutworms the next year.**

**If there are more than fifteen "wet" days during the period of larval activity, little trouble may be looked for from this insect the following year.**

### Control Measures

At present there is no practical method of controlling the pale western cutworm when it has once appeared in a crop and is causing damage. It is possible, however, by cultural methods to prevent an infestation in a particular field the following year. Since the moths always select a place where the soil surface is soft and dusty, in which to lay their eggs, the location of the infestation during any year is largely determined by the condition of the soil surface during the egg-laying period the previous year.

Fields which are to be summer-fallowed must be worked early, and thoroughly cultivated during June and July to destroy all weeds. **All work on the fields to be protected from cutworm invasion must be stopped by August, and the fields left undisturbed until the middle of September.** This will allow any showers to form a crust over the surface of the soil, thereby making

such ground unsuitable for egg-laying. If this crust is not broken up by cultivation or any other means during the time the moths are flying, the field will be reasonably free from cutworms the following year. Stock should not be allowed to run over this summer-fallow, as they will break up the crust as effectively as will cultivation.

It must be fully realized that the effectiveness of this control of the infestation is dependent on showers or heavier rainfall late in July or early in August to crust the soil surface effectively. The presence or absence of weeds or stubble has little to do with the egg-laying and a crusted weedy field is in a much better condition to avoid infestation than a clean dusty field.

If summer-fallow is thoroughly worked up to the last of July so that there is no weed growth present, any weeds which might start with subsequent showers will make but little growth by the middle of September. The chances that such weed growth will proceed to the extent of producing seed are practically nil.

Fields which are in a crop that cannot be harvested before August 1 nor left until the middle of September are very liable to infestation the following year. Wherever possible such fields should be summer-fallowed the following year, especially if the forecast for an outbreak indicates that cutworms are likely to be present.

If an autumn grain crop is to be sown it is advisable to seed before August 1, if possible; if not, the seeding should be left until after the middle of September. Autumn-sown wheat and rye are not immune from cutworm attack and seeding during August is sure to leave the field with a soft and dusty surface.

There is some evidence to show that late autumn ploughing or early spring ploughing, before the first of May, are effective control measures, but this is not conclusive enough to be used as a definite recommendation. Of the two procedures spring ploughing before May 1 is probably the more effective in the greater number of cases. Ploughing after May 1 is usually quite ineffective.

Packing, rolling, harrowing, disking, using a press drill, or changing the date of seeding spring crops, make little difference in the damage that may be done by the cutworms. If there are not many cutworms present in the field a thorough packing of the soil across the drill rows will retard the progress of the cutworms and reduce the damage. If there are more than fifteen cutworms per square yard they will destroy the crop in spite of the most careful packing.

No effective poisoned bait for the pale western cutworm has yet been discovered. There are some conditions under which any poisoned bait would be effective, but the chances of having the bait ready when the conditions are right for using it are so slender that it is not economical.

No seed treatment or soil poison has been found which is economically effective.

The moths are readily attracted to light and sugar solutions, but the numbers which are caught by light traps or poisoned baits are so insignificant when compared to the total population that neither is recommended as a control measure. Lights may be used to determine whether or not moths are present in any particular locality, but the lights would have to be kept running for the greater part of the flight season. The same information can be gathered more accurately by observing patches of flowering weeds near cultivated fields in the late afternoon and noting the species of moths that are feeding.

Where the infestation in a field is very patchy and there is danger of these patches becoming larger, a furrow may be ploughed around them with a straight side towards the uninjured grain. This furrow will not stop the movements of the cutworms, but it will retard their progress and turn some of the larvæ back into the part of the field already injured.

There is only one efficient way to ascertain whether or not any particular field is infested with cutworms. This is by means of "indicator strips" of

grain. As early in the spring as possible one drill width of grain should be seeded diagonally across the field or if desired two diagonals may be sown. The rest of the field is then cultivated for the regular crop. The weather conditions which germinate the seed and start the grain growing will also hatch the cutworm eggs. When the grain in the strips is four or five inches high it should be carefully examined for signs of cutworm damage on the leaves. About one square yard of plants should be examined in every 100 feet along the indicator strip. If from fifteen to twenty plants in each square yard show definite signs of injury it is not safe to seed the field. If no injury is found the strips of grain may be cultivated and the entire field seeded at once. This plan has been used with success, and while it has a tendency to delay seeding for a short time definite information should be available by May 10 or 15.

It is not practical to attempt to determine the liability to economic loss by proving the presence or absence of eggs in a field by any known method of soil sampling. The distribution of eggs is not generally uniform and unless the samples of soil happen to be taken from the right spot the results might be very misleading.

In areas where soil drifting is common much of the work of preventing infestation in a field may be upset by a heavy wind. A summer-fallowed field which has been worked during August and received an accumulation of eggs may drift in a heavy wind. The eggs drifting with the soil may come to rest in fields in which no eggs had been laid, causing an infestation there. Fortunately the great majority of eggs are laid in stubble fields, as there is usually a greater area of land with a loose surface soil in stubble than in summer-fallow and the stubble prevents serious drifting.

## Crop Rotation

A rotation which includes crops that will allow the field to be left untouched from August 1 to September 15 each season will permit the farmer to produce something each year. Since spring wheat is sure to be harvested some time during this period, it can only be used once in the rotation and then just preceding summer-fallow. A suggested rotation is as follows:—

First year—Summer-fallow, not touched between August 1 and September 15. Seed fall rye before August 1 and pasture it after September 15.

Second year—Harvest fall rye before August 1 and thresh after September 15, leaving the field undisturbed between harvest and threshing.

Third year—Seed oats or barley as a nurse crop for sweet clover and cut for hay or green feed about July 15. Do not touch the field until after September 15, when it can be pastured.

Fourth year—Cut sweet clover for hay the last of July or for seed the middle of September.

Fifth year—Spring wheat.

## Reseeding

**There is danger to a second seeding if it is sown too soon after the first crop has been destroyed by the pale western cutworm.**

Unlike some other cutworms, this species does not move out of a field after the crop has been destroyed. The larvæ remain where they are and feed largely on weeds or old straw and stubble in the soil. It can easily be realized that as these cutworms are able to destroy the first crop while they are still rather small that they will do as much damage to a second seeding, especially as the grain is smaller and the cutworms somewhat larger.

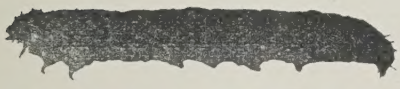
No field in which one crop has been destroyed should be reseeded as long as the cutworms are present and feeding. The following chart indicates approximately how long it will take cutworms of various sizes to become full grown and how soon it will be safe to reseed:—

($\frac{3}{4}$-inch)—Do not reseed in less than five weeks.

($\frac{7}{8}$-inch)—Do not reseed in less than four weeks.

(1-inch)—Do not reseed in less than three weeks.

($1\frac{1}{4}$-inch)—Do not reseed in less than two weeks.



($1\frac{1}{2}$-inch)—Full grown. Sow in about one week's time.

In using the chart it is necessary to gather a number of average-sized cutworms from the infested field, making sure that they are taken from areas where some food still remains. If taken from spots where there is no vegetation the larvæ may be starved and undersized although nearly mature. Drop the cutworms in water and leave them until all movement stops and then compare them with the figures on the chart. To the right of the figure will be noted a statement indicating how long the field must be left before it is safe to reseed. Since the larvæ develop more rapidly under some conditions than others, these measurements should be repeated every ten days.

Practically all field crops are subject to attack by the pale western cutworm and the reseeding of any crop in an infested field is risky. Flax, oats, and barley are as readily eaten as wheat, but can be sown after the cutworms have disappeared, with reasonable certainty of getting a crop.

Ottawa: Printed by F. A. Acland, Printer to the King's Most Excellent Majesty, 1931.